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Potato Growing in Ohio

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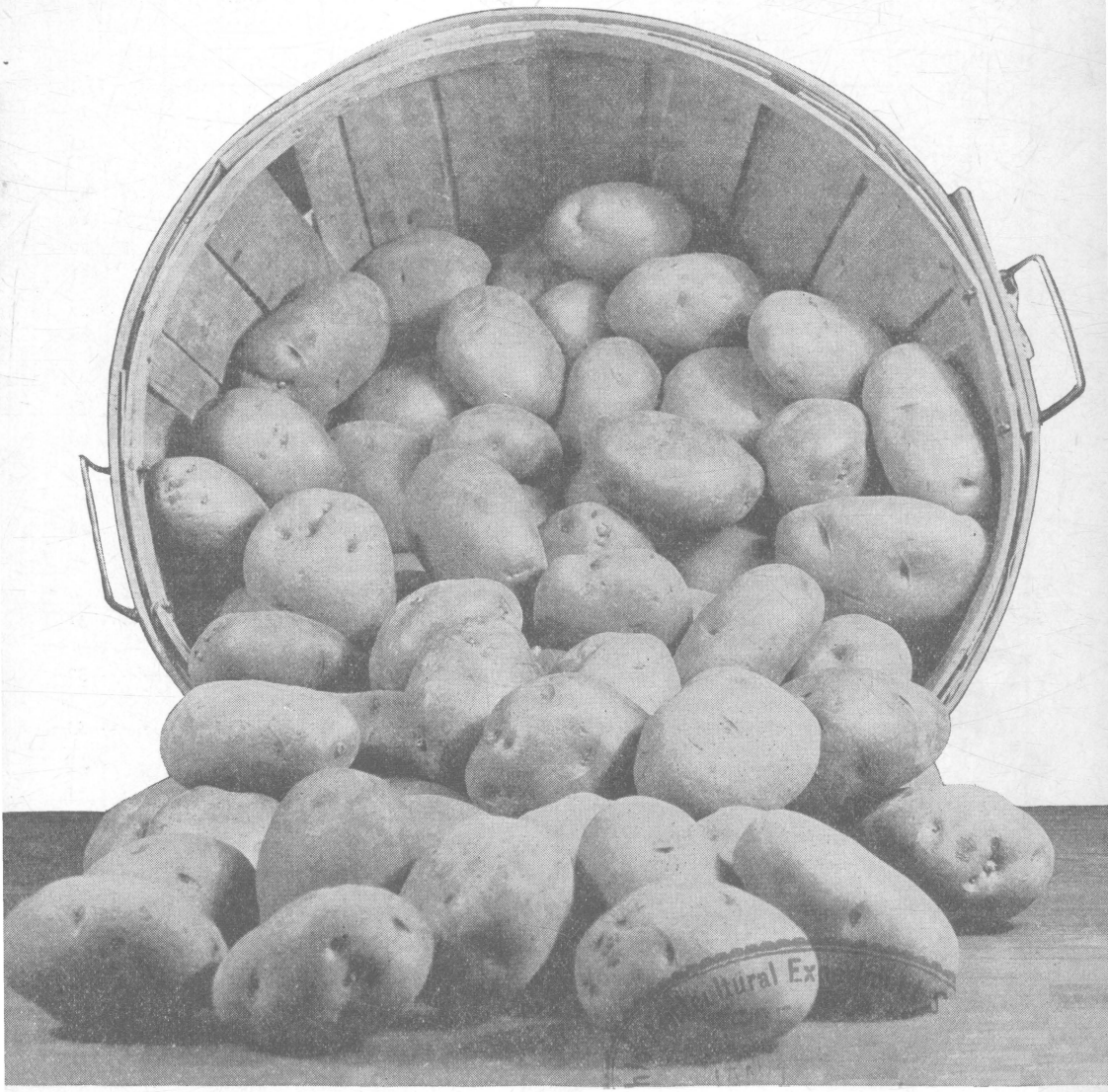

Requirements for Potato Growing

1. A well drained *soil,* loose at the time of planting and remaining so throughout the season.
2. Good seed in firm condition. Use *certified seed* of suggested varieties.
3. *Fertilizer.* Use 1,000 to 2,000 pounds per acre of a suitable analysis.
4. Spray at least 8 to 10 times to control insects and diseases.

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This bulletin is a revision of Bulletin 86, "Potato Growing in Ohio" by the late Earl B. Tussing. Sections on disease and insect control were prepared with the cooperation of J. D. Wilson and Jay Sleesman, of The Ohio Agricultural Experiment Station.

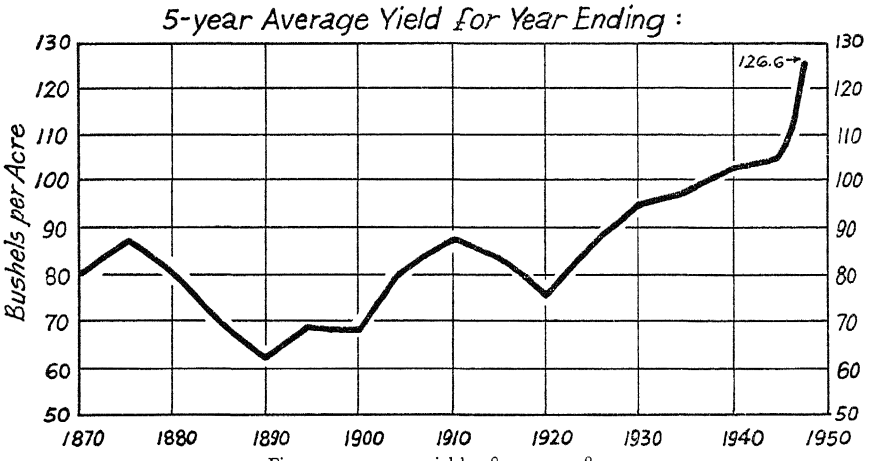
Potato Growing in Ohio

The acreage of potatoes in Ohio has declined from a high of 213,000 acres in 1909 to an estimated 43,000 acres in 1948. During this same period the average yield per acre has increased from 90.8 bushels (1906-1910 av.) to 126.6 bushels (1944-1948 av.). The increased yields can be accounted for through the use of more favorable soils, increased use of fertilizers, better varieties, and newer insecticides, especially DDT.

In spite of the increased yields per acre, Ohio produces only about one-third of the potatoes consumed in this state each year. Ohio potatoes supply a large part of the market volume from about August 1 until early winter. Shortly after the first of the year, and continuing through July, Ohio markets are supplied from shipping states, such as Maine, Michigan and Idaho, and from early crop states in the South and California.

Ohio is south of the large potato belt, which has a more favorable climate for potato production. The warmer climate of Ohio has often been blamed for the decline in acreage. However, other factors include:

1. Limited acreage of soils well suited for potatoes.
2. Increased mechanization.
3. Conversion of some potato soils into production of more intensive vegetable crops.
4. Increased grading and packing requirements.
5. Discouraging yields.
6. Shortage of labor.
7. Competition in markets from larger production centers.

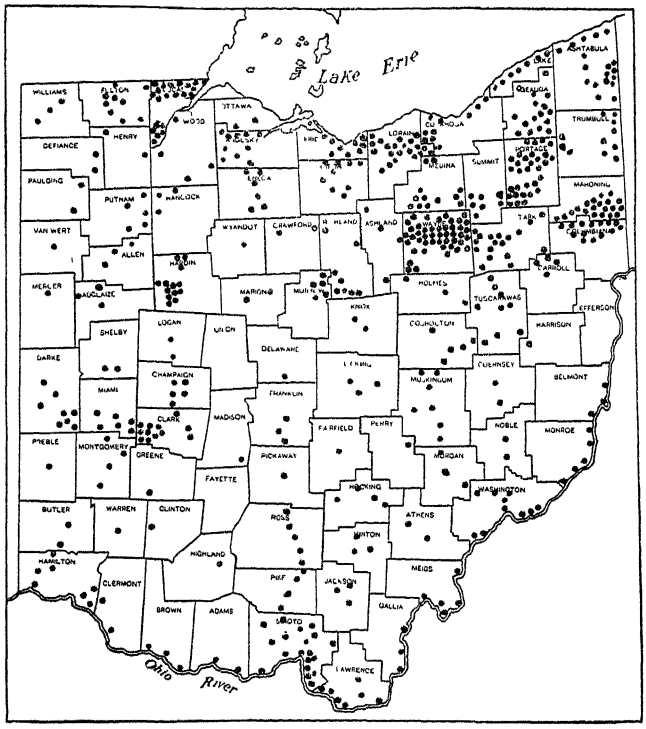


Five-year average yield, 1870 to 1948.

In spite of our warmer climate and other problems of production, the potato is still an important cash crop on many Ohio farms. The disadvantages in production are offset by the advantages of nearby markets and low shipping costs.

The world production of potatoes in 1946 was 7,132,936,000 bushels of which the United States produced 425,131,000 bushels. Among the 37 major potato growing states, Ohio stands 16th with a crop of 7,560,000 bushels in 1946. The 15 states with a greater annual potato production than Ohio are Maine, Idaho, New York, California, Pennsylvania, Colorado, North Dakota, Michigan, Minnesota, New Jersey, Oregon, Wisconsin, Nebraska, Virginia and Washington.

Centers of Production in Ohio



Approximate distribution of potato acreage in Ohio, 1945.

Potatoes are grown to some extent in every county in Ohio. The important centers of production are restricted to well drained soils, such as the Wooster silt loams of northeastern Ohio, the sandy and gravelly soils of northwestern and central Ohio, and to well drained mucks. In southern Ohio, the most successful production is on the terrace soils of the Ohio River and its tributaries.

During the past 10 years, the acreage of potatoes in the northeastern counties has decreased while the acreage in central and southern Ohio has increased. The decreased acreage in northeastern Ohio is due mostly to unfavorable soils and the shift to other farming interests. In central and southern Ohio, early and midseason varieties of potatoes constitute most of the increased acreage.

Some Economic Considerations on Size of Potato Growing Operations

Much of the equipment necessary for potato growing is of little or no value in the production of other crops. This equipment includes planters, sprayers, diggers, and sorting machinery especially designed for potatoes. In addition to the machinery itself, there are items of building space to house the equipment, and to provide a place for sizing, grading, bagging, and storage. The ground level of a barn about 30 by 50 feet is needed to give ample room for handling the crop from 25 acres. This space is in addition to space needed to house the planter, sprayer, and digger.

Buying seed by the carload can mean a substantial saving. One car holds at least 360 one hundred pound bags, which plants between 20 to 30 acres, depending on the spacing and size of seed pieces.

It is questionable whether the expensive implements would be justified for an enterprise of less than 25 acres. In some sections of Ohio, the use of custom work for planting, spraying, digging, grading, and storing permits many smaller growers to grow potatoes. These individual growers would not be able to stay in the business if each one had to buy the expensive equipment needed for potato production.

Soils for Potatoes

Most of the soils in Ohio are not adapted to potatoes. Either they are poorly drained or the texture is not sufficiently loose. On soils that do not drain rapidly, the yields are often disappointing, the tubers are dark in color and of poor shape and cooking quality. The best potato soils have a subsoil that drains as rapidly as the plow layer. On the heavier soils, good crops can be grown with adequate under-drainage, special rotations, and care in handling the soil. Following is a list of the best potato soils in Ohio.

Northeastern Ohio

Upland Soils:

Wooster silt loam

Terrace Soils:

Chenango loam, and silt loam

Braceville loam

Lake Plain Soils:

Reynolds fine sandy loam

Painesville fine sandy loams, and loam

Northwestern Ohio:

Lake Plains Soils:

Toledo fine sandy loam; very fine sandy loam; and loam

Wauseon fine sandy loam

Maumee fine sandy loam

Lucas fine sandy loam; and very fine sandy loam

Belmore loam

Western Ohio:

TERRACE SOILS:

Fox loam; and silt loam

UPLAND SOILS:

Bellefontaine silt loam
Milton silt loam
Miami silt loam
Brookston silt loam

Southwestern Ohio

TERRACE SOILS:

Fox fine sandy loam; loam, and silt loam
Wheeling silt loam; and very fine sandy loam

Southeastern Ohio

TERRACE SOILS:

Wheeling loam; and silt loam
Chenango; loam, and silt loam
Fox loam, and silt loam

FLOOD PLAIN SOILS:

Huntington silt loam—high bottom phase

It is questionable whether soils other than those named should be used for potato production.* Certainly, high average yields could not be expected on the heavier soils. As an aid in appraising soil for potatoes, a soil survey is useful. These surveys are kept in the county agent's office and may be studied on request. Surveys made since 1925 are most useful. Before going in the potato growing business the soil should be checked against the above list or its type and drainage compared with the listed soils.

On sloping land, erosion is a serious problem. In planning to grow potatoes on such land, terracing, strip cropping, and contour planting should be considered in an effort to conserve moisture as well as soil.

Acidity of Soil

Most Ohio soils do not need to be limed to grow potatoes. In fact, an acid soil is preferred because the acidity helps to reduce potato scab. The proper acidity is a pH of 5.0 to 5.5. Most of the soils of eastern Ohio are near this range. If a soil test shows that the pH is below 5.0 the soil may be limed at a moderate rate—½ to 1 ton per acre.

Some growers prefer to grow sweet clover or other legumes in the rotation. These legumes do not grow well at the pH scale recommended for potatoes. Soils that have been limed sufficiently to grow legumes may produce potatoes that are badly infected with scab. However, the risk can be reduced by waiting 2 or 3 years after liming before planting potatoes in these fields.

* Well drained muck soils are excellent for potatoes. In regard to some special problems of growing potatoes on muck soils see Ohio Experiment Station Bulletin 570.

Where legumes are not grown, and where the pH of the soil is between 5.6 and 6.0, there is occasionally some advantage in using sulfate of ammonia as the nitrogen carrier in the fertilizer because it has a slight acidulating effect.

Rotations

Potatoes are not generally adapted to ordinary farm crop rotations. Potatoes produce best on acid soil; and potatoes planted on a grass sod are likely to be injured by grubs and wireworms.

The aim is to have a green manure crop preceding the potatoes in the rotation, to leave the soil loose and friable, and free from white grub or wireworms. Muck

Plowing down a soil improvement crop.

and some sandy soils do not need a special rotation, but most Ohio soils are too heavy, and special crops are grown to prepare the soil for potatoes.

Rotations for Early Potatoes

On better potato soils, early potatoes may be grown year after year by seeding barley or rye as a green manure crop immediately after digging the potatoes. Winter barley is preferred for southern Ohio because it can be seeded in August, 2 or 3 weeks earlier than rye, and makes a larger fall growth. Rye is preferred in the northern half of the state as barley sometimes winterkills in that section. The suggested planting dates for these green manure crops are as follows:

Barley for southern Ohio	August 15
Rye for northern Ohio	August 15
Rye for central Ohio	August 25

The sooner the seeding is made, after the above dates, the better will be the growth, and the more completely the roots will fill the soil.

Where early potatoes are included in a vegetable rotation, the preceding crop should be one such as sweet corn that is harvested early enough to allow for seeding the winter cover crop in ample time.

Rotations for Late Potatoes

Late potatoes cannot be grown year after year as successfully as the early crop because the late digging prevents early seeding of the winter cover crop. Two-year rotations are widely used. The most common one is to follow potatoes with wheat, and sow a legume in the wheat in late winter or early spring. Sweet clover or alfalfa are naturally preferred on soils high in lime and also on slightly acid soils that are very fertile. On more acid soils that will not produce a good growth of alfalfa or sweet clover, mammoth red clover or alsike clover are commonly used.

If the potatoes are dug too late in October to seed wheat, oats may be sown in early spring, and the field seeded to clover. Many growers combine the grain and leave the straw on the field. The following spring the clover is allowed to grow until sometime in May before plowing for potatoes.

One weakness of this 2-year rotation is that when the normal seeding of wheat or oats is made, following a crop of potatoes, the grain crop often grows so rank the clover seeding fails. In cases where the clover seeding does fail, the grain stubble may be disked and the field seeded either to winter barley or rye at the appropriate time. If the stubble can be disked and reseeded in July, rye grass is a good cover crop that can be planted this month. Rye grass does not have the disadvantage of growing so tall the following spring that it cannot be properly plowed under for late potatoes. On the other hand, even though winter barley or rye may grow so tall it is difficult to turn them under, it is more important to plow heavy soils when they are mellow than to attempt to plow at any definite stage in the growth of the green manure crop.

In some of the northern counties, wireworms become serious in 2-year rotations including a grain crop. In such areas, some rotation must be adopted which has no protecting cover for the adult beetles at the time of egg-laying in late May and early June. After late potatoes, the ground is left fallow over winter and soybeans or corn seeded in early June. These crops are best plowed under for soil improvement, but they may be cut for feed in August. In either case, rye or winter barley is seeded about September 1. Planted this early the cover crop produces an excellent sod which is plowed the following spring before the middle of May, even though the potatoes are not planted until sometime in June.

Fertilizers

Potatoes require more fertilizer than most farm crops. The potato plant is relatively shallow rooted and is not so successful as many other crops in drawing on the natural fertility of the soil. A 400-bushel per acre crop contains approximately 184 pounds of nitrogen, 43 pounds of phosphoric acid, and 230 pounds of potash. The distribution between tops and tubers is shown in Table I.

Table I. Nitrogen, Phosphoric Acid, and Potash in a 400-Bushel Crop of Potatoes

	In the Tubers	In the Tops	Total Pounds
Nitrogen	84	100	184
Phosphoric acid	32	11	43
Potash	140	90	230

For early potatoes grown year after year with winter cover crops and for late potatoes in a 2-year rotation, the recommendations for fertilizing are as follows:

Early crop without manure..... 1500 pounds 5-10-10
Late crop without manure..... 1500 pounds 5-10-10 or 3-12-12
On muck soils without manure..... 1000–1500 pounds 0-9-27, 0-10-20, or 3-9-18

These recommendations do not apply to all soils and conditions. They should be modified according to the judgment of the grower, taking into consideration the yield expected, amount of manure applied, rate of planting and irrigation.

1. The yield expected. Fertilizers alone cannot be expected to produce large yields. The other three essentials—soil, seed, and spraying—are necessary. If the soil will not produce large yields because it packs, lacks organic matter, etc., or the seed will not yield well because of disease, poor storage, etc., and a thorough spray program is not followed, then the amount of fertilizer should be correspondingly reduced.

2. The amount of manure applied. Manure is an excellent source of fertility for potatoes, and for each ton added per acre, the fertilizer is reduced 50 to 75 pounds. For example, if 10 tons of manure are applied, the fertilizer application is 750 pounds. If the manure is strawy or stalky, the proportion of nitrogen in the fertilizer should be somewhat increased.

3. Rate of planting. Within limits, the closer the seed is spaced, the higher should be the rate of fertilizer applied. A simple rule that fits most conditions is to apply the same amount of fertilizer as the weight of seed planted.

4. Irrigation. Heavier planting rates, consequently heavier fertilization, are profitable when potatoes are irrigated.

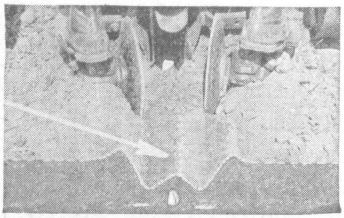
Special Fertilizer Mixtures

Some growers desire to use a special formula of fertilizer or a special ingredient as a part of the fertilizer mixture. For instance, in soils containing too much lime for potatoes (pH above 5.5) there is some merit in using sulfate of ammonia as the nitrogen carrier, as this material has some acidifying effects.

Therefore, there are a few cases where custom-made fertilizer or home-mixed fertilizer might be justified. However, unless unusual soil fertility problems arise, it is doubtful whether it pays to try to purchase or home mix formulas other than those recommended and offered for sale in this state. Where unusual problems do arise concerning the need for special formulas, custom plants operating in the state will usually cooperate in mixing such a formula.

Placement of Fertilizer

The usual method of applying fertilizer is in the row at planting time; but if the fertilizer comes in direct contact with the seed, burning will result. The best placement is in narrow bands about 2 inches to the side of the seed and on the same level.



Fertilizer placed in bands, with shallow covering of seed pieces.

Most modern potato planting machinery is designed to place the fertilizer properly. However, where large disks are used for covering, placed so that a ridge is thrown over the seed, the fertilizer will be picked up and moved above the seed piece. Planting so that a furrow is left with a small amount of soil over the seed will avoid this difficulty.

Where very large yields of potatoes are expected, and more than 1,500 pounds of fertilizer per acre is to be used, one-third to one-half of it should be applied prior to plowing, and the balance applied in bands along the row. When too much fertilizer is applied in bands at the side of the seed, restricted root growth often results. Premature dying of the foliage and reduction in yield follows.

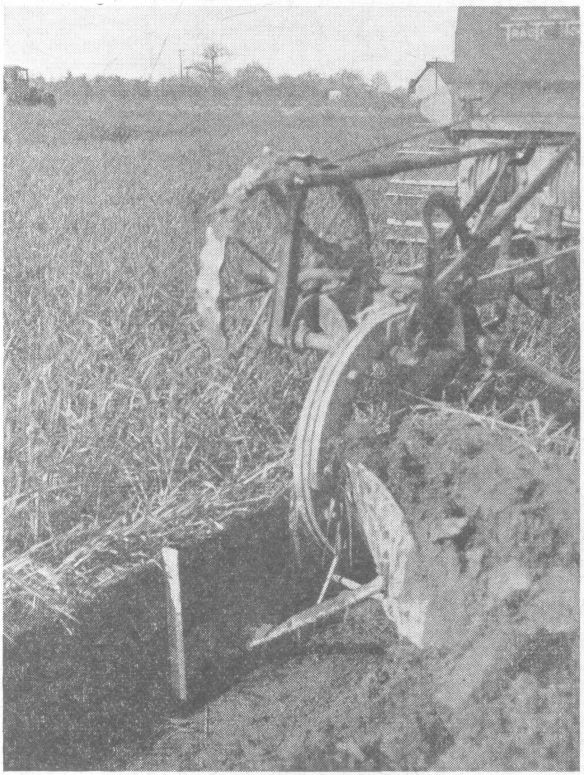
Deep tillage tool, usually known as an orchard cultivator.

Preparation of the Seedbed

Deep plowing is essential for potatoes, and many growers plow to a depth of from 7 to 10 inches, but if the field has been plowed shallow previously, then increase the depth by about ½ inch per year. The roots develop mostly in the plowed layer; the deeper the soil is plowed the deeper the roots extend.

Too often growers overfit their soil, disking the top few inches until it is almost a dust, thus preventing deep planting and good aeration. Beating rains pack and seal this finely worked soil, reducing aeration still further.

Sandy and gravelly soils provide a maximum of aeration and may be plowed at any time. This is not the case with the heavier soils. For early planting, before the middle of May, the most successful and economical method is to plow them when the soil shatters, and plant immediately with little or no further soil preparation. This procedure helps to keep the soil loose and porous throughout the season.

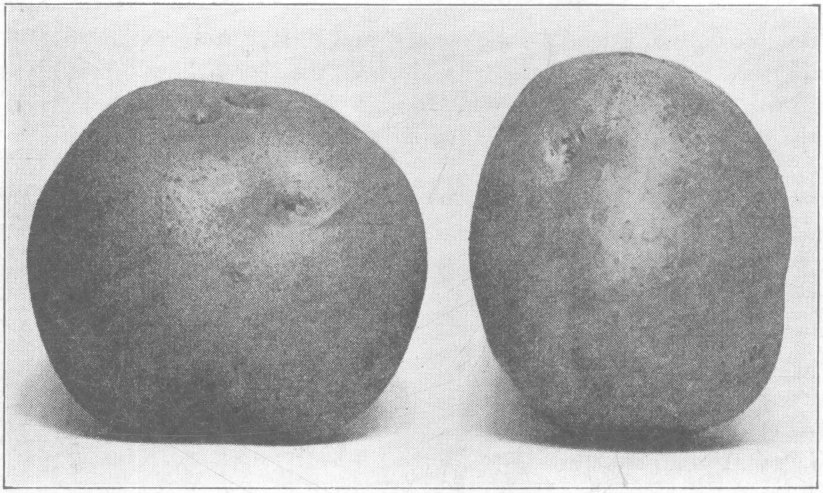


Plowing 11 inches for potatoes at the Ohio Agricultural Experiment Station.

For the later plantings, if the plowing is delayed until just before planting, the soil may become too dry or the cover crop may become exceedingly tall. Therefore, the best time to plow for the late crop is whenever the soil is in the best condition for plowing. It then needs to be harrowed sufficiently to retard drying out. If rains follow, the soil must be loosened before planting. Immediately before planting, a deep tillage tool should be used, stirring the soil from the bottom of the furrow. This is the most important cultivation, since it is impossible to cultivate the soil near and under the seed piece after planting.

Potato Varieties

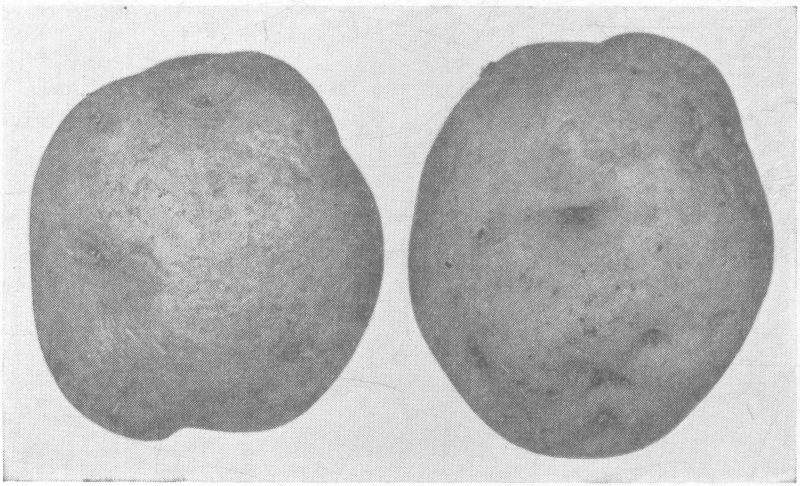
Irish Cobbler and Katahdin represent nearly 90 per cent of Ohio's commercial acreage. The acreage of these two varieties are nearly equal and the balance of the



Irish Cobbler, the most important early variety.

acreage includes such varieties as Russet Rural, Sebago, Chippewa, and Pontiac. It is best to plant the widely used varieties until tests have shown a minor variety to be better for a given farm.

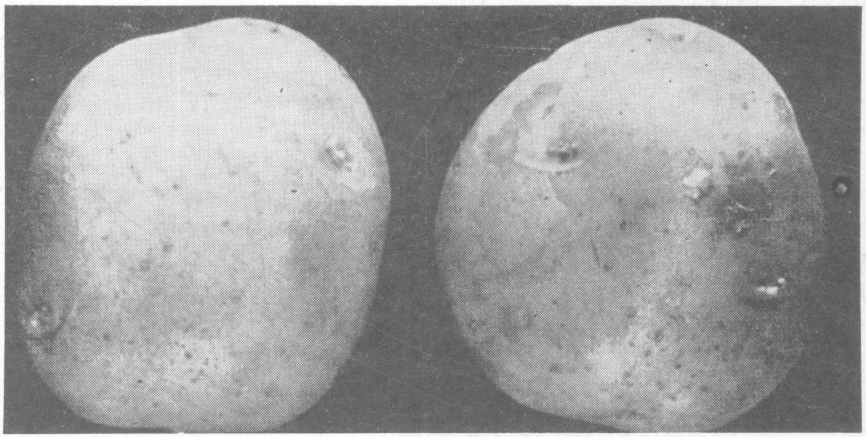
Irish Cobbler is the standard early variety in Ohio. It is of excellent cooking quality, although deep eyes and variable shape make it fairly unattractive in appearance. Irish Cobbler sells readily during its harvest season but should not be held until later smooth varieties are available, when sales become difficult due to its rough appearance. Planted April 1 in southern Ohio it is ready to dig in July; its growing season is 100 to 110 days. The variety responds to irriga-



Chippewa, one of the newer varieties.

tion and some growers consider irrigation essential to successful production of Cobblers.

Katahdin is the most popular main crop variety. The tubers have an attractive flattened oval shape, white skin and, shallow eyes. Russet Rural or Pontiac may yield more than Katahdin, but the high percentage of first grade tubers and attractive appearance make Katahdin more satisfactory. The cooking quality is as



Katahdin, most popular variety in Ohio.

good as other late varieties grown in Ohio. The tubers set shallow and deep planting as well as slight hilling are desirable to prevent exposure of the tubers to the sun and losses from greening. Planted May 1, it is ready to dig in September, the growing season being 110 to 120 days.

Russet Rural matures with Katahdin or slightly later and is similar in cooking quality. Because of the dark russetted skin, it is unacceptable in markets and is now grown principally for chipping. Manufacturers find that chips made from Russet Rural are of high quality and they encourage its production for their use.

Minor varieties grown in Ohio include the following: *Sebago* is a late variety with some resistance to late blight. The tubers are less uniform and not as attractive as Katahdin and are satisfactory for chipping purposes. *Chippewa* is an early variety, 7 to 14 days later than Cobbler. Eyes are shallow. It out-yields Cobbler on muck soil and is preferred for making chips. Because wounds and skinned spots are slow to heal, decay often starts soon after harvest. Chippewa should be grown only when the crop will be used very soon after digging. *Pontiac* is a heavy yielding, late, red-skinned variety that may be somewhat coarse grained when cooked. The color fades soon after harvest, becoming grayish and so unattractive as to make the tubers unsalable. Small acreages may be marketed in some areas but only in a very limited way. *Kennebec*, introduced in 1948, has out-yielded Katahdin in tests, is better in cooking quality, and is resistant to late blight. Tubers are cylindrical and perhaps not quite as attractive as Katahdin. Kennebec merits trial as soon as seed is available. *Erie, Menominee,* and several other varieties are also grown in a limited way in some sections.

Seed

The only reliable procedure in selecting potatoes for seed is to obtain them from a field known to be free from virus diseases and also free from other serious tuber-borne diseases, such as ring-rot and fusarium. As it is easier to produce disease-free seed farther north than in Ohio, the production of seed potatoes has become a specialized business in northern states and Canada.

Certified Seed

This refers to potatoes that have been specially grown for seed purposes under rigid rules and inspection by state authorities. The procedure is designed to insure seed that is as free from disease as it is practical to produce, and to insure that it is correctly named as to variety. Because the producer must carefully rogue all plants showing any symptoms of disease, and in addition pay for the inspections, certified seed is higher in price than table stock. Certified seed is not always free from scab and rhizoctonia. Because these diseases may be controlled by seed disinfection, the rules allow 5 percent on certified seed. Generally, the seed shipped to Ohio has only a small amount of these diseases, and, consequently, most certified seed does not need to be disinfected. Occasionally certified seed potatoes are infected with diseases other than scab and rhizoctonia, but this is usually not the case. Even though certified seed is safest and best to plant over a period of years, traces of serious diseases may pass the inspection unnoticed and cause losses to growers.

Seed Sources

Seed may be bought in carload lots from centers of production. Growers using less than this quantity may either pool their orders or buy from local dealers. Much of the certified seed used in Ohio is shipped from Maine, with smaller quantities from Michigan, New York, Minnesota, North Dakota, and Canada.

Use of Home Potatoes for Seed

Most commercial growers plant certified seed every year. This is the safest practice. It is often satisfactory to plant potatoes that were grown from a late-planted field of main crop potatoes the previous year, providing certified seed was used the previous year, and the field of growing potatoes showed *no disease*. The use of potatoes 2 years from certification usually results in lower yields. The grower who plans to save potatoes for seed must learn to recognize the symptoms of diseases on the growing plants.

Cobblers from the spring crop are not satisfactory for seed. They often sprout in storage during the fall before cooling. Even if they do not sprout in storage, when used for seed, too many sprouts develop from each seed piece. This "multiple sprouting" is due to the age of the tubers when planted. The desired two or three sprouts "developing from each seed piece is only obtained on seed from a late planting the year before. In general, potatoes are at the best stage for

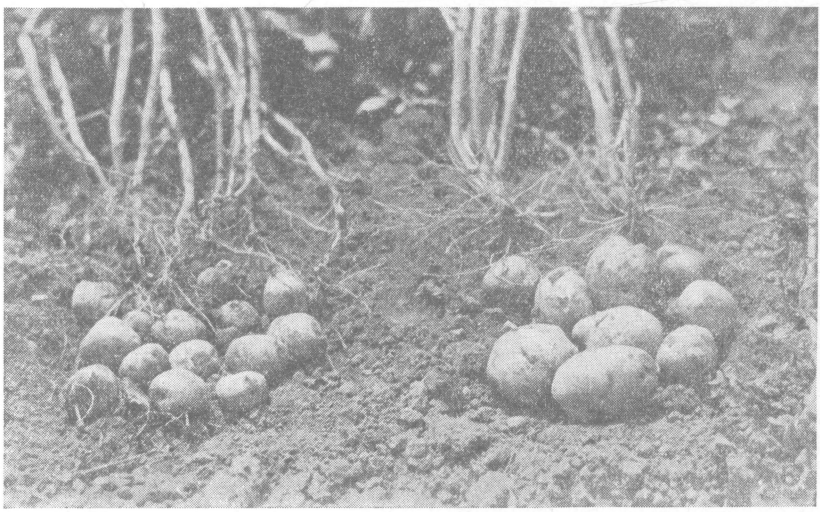
planting about 11 months after the date the crop they came from was planted. Cobbler seed saved from an early spring crop develops too many plants per hill, and the result is too many tubers, and too small tubers. The problem of multiple sprouting on Katahdins is not so severe. In fact, the additional sprouts might help in getting a larger set of tubers which would develop into average-sized potatoes rather than a few over-sized tubers, as is often the case with this variety.

Small Whole Potatoes for Seed

It is not advisable to plant small tubers from a crop that has not been thoroughly rogued. The practice of planting small tubers without any selection, or those from unrogued fields, invariably results in disaster. If a seed plot is maintained or if certified seed is used, the small tubers need not be rejected. A small tuber taken from a disease-free hill will produce as good or better yield than a cut piece from a large tuber taken from the same hill. If soil or weather conditions are unfavorable at the time of planting, a better stand is obtained from whole than from cut seed.

Warming Seed for Early Planting

Certified seed is usually cold and dormant when taken from the car. Cold potatoes, cut for planting, do not heal rapidly. Therefore, it is best to warm the seed for a short time (2 to 4 days) before cutting and planting. Holding the seed at a temperature of around 50° F. for a short time warms the seed and encourages sprout growth. The potatoes will then come up quicker and the stand will be better.



Two hills of Irish Cobblers. Left—Seed from a crop planted early and held for planting the following spring. Note the number of stalks and heavy set. The tubers did not size. Right—A hill from certified; two stalks and fewer tubers, which sized well.

The Care of Seed for Late Plantings

When conditions make it impossible to plant until June, some special care must be given the seed for late plantings to prevent excessive sprouting and shrivelling. The potatoes should be held in a cool storage with a high humidity. The high humidity can be maintained by sprinkling the potatoes once or twice a day, but they must not lie in pools of water.

Green Sprouting

This consists of placing the uncut seed on the floor of a barn or on boards in partial shade outdoors. The potatoes are placed in a layer 6 to 8 inches deep. The best temperature is between 60 to 70° F. In 10 days to 2 weeks short, green sprouts will develop. This seed will come up quicker than seed not green-sprouted, an advantage where rapid emergence is desired.

Seed Treatment

Two principal diseases can be controlled on the seed by seed treatment. These diseases are scab and rhizoctonia (black scurf). However, seed treatment will not protect the growing crop from becoming infected when planted in infected soils. As most soils in Ohio are infected with these organisms, seed treatment is of little value. Scab is more easily controlled by regulating the soil acidity. Rhizoctonia is most troublesome on early crop potatoes under cold, wet conditions. Therefore, about the only advantage to be gained by seed treatment is to reduce sprout injury by rhizoctonia.

Yellow Oxide of Mercury

Two pounds of yellow oxide of mercury (technical grade) thoroughly mixed in 30 gallons of water is sufficient to treat about 200 bushels of seed. The mixture is prepared in a wooden container, such as a half-barrel, or a metal container coated on the inside with asphalt paint. Two or more coated baskets that nearly fill the barrel are needed. Fill the baskets with potatoes and plunge up and down in the liquid three or four times. Then let the liquid picked up by the potatoes drain back into the barrel or vat. The solution does not lose its strength and can be re-used. Avoid metal in contact with the solution.

Corrosive Sublimate

Potatoes treated with corrosive sublimate must not be used for cooking, nor should stock be permitted to drink any of the treating solution. Following are the steps for using this material:

1. Heat 1 gallon of water to near boiling; transfer to wooden pail.
2. Dissolve 8 ounces corrosive sublimate in the hot water.
3. Transfer this stock solution to a jug or stoppered glass container, after cooling. Label containers, as material is deadly poisonous.
4. Into a wooden vat or barrel, place 2 quarts of the stock solution and 30 gallons water. This will treat 4 bushels of potatoes. Allow the potatoes to soak for 1½ hours.

5. After treating each batch of seed (4 bushels) add about ½ pint of the stock solution and enough water to bring the level back to 30 gallons, since the material loses its strength with use.
6. After treating 7 or 8 batches, discard the old and resume with new solution.

Organic Mercury

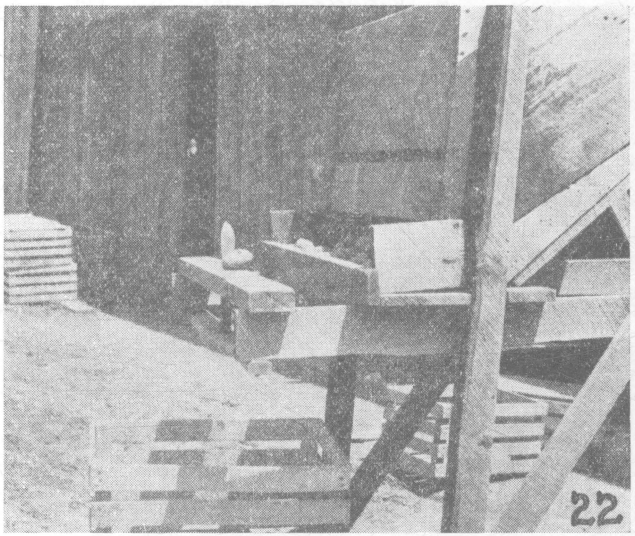
Organic mercury compounds which are on the market for treating potatoes are fairly economical and efficient. These should be used according to manufacturer's directions.

Cutting Seed

Seed pieces should be cut blocky rather than wedge shaped, as blocky pieces produce sturdier sprouts. They also insure more accuracy in planting, especially when the picker type planter is used. Each seed piece should have at least one eye centrally situated rather than at the edge of the piece.

To facilitate the cutting of potatoes, a low table may be used with lath tacked around the edge. This prevents the potatoes from rolling off the table as they are piled loosely. The cutters are seated about the table, using very thin, sharp knives; the potatoes are cut, using the table for a bearing, steadying the potato with one hand and cutting with the other. A crate is placed beside each cutter; when a number of potatoes are cut they are pulled into the crate through a convenient opening in the lath.

A cutting box, as illustrated, is built with a hopper which feeds the potatoes to the operator. A thin knife, sharpened on both sides, is placed in a 2 by 4. A crate is placed under the knife to catch the cut pieces. If the potato is to be cut in three pieces, it should first be drawn toward the operator, thus cutting off the stem end, which is dropped into the crate; the seed end is then turned and split.



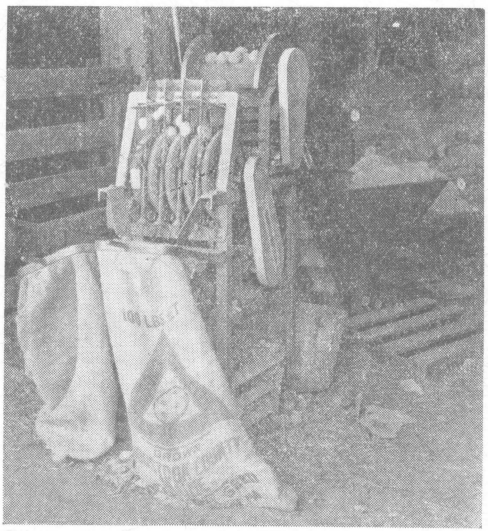
A seed cutting box with hopper feed.

In recent years of labor shortage, mechanical cutters have come into use in Ohio. To operate the popular type, a row of tubers is laid by hand on the cutting surface in such a way as to give minimum of thin slices, and to have these wasted slices cut from the stem end rather than from

the bud end of the tubers. Mechanical cutters are more successful on small and medium size tubers than for large seed.

Size of Seed Pieces

As a means of insuring a good stand, the seed piece should weigh at least 1 ounce. Under ideal conditions a smaller seed piece will be satisfactory, but if the seed is planted deep, or if heavy rains pack the soil, the sprout may never reach the surface. Therefore, seed pieces cut blocky to average 1 to 1½ ounces and containing one or more eyes should prove most economical.



Machine for cutting "B" size seed. Smaller tubers are left whole, larger are cut into two pieces.

A cubical 1 ounce piece measures slightly more than 1⅛ inches each way. In actual cutting operations, where a minimum of an ounce is the aim, the average weight will range from 1¼ to 1½ ounces. Small tubers of this weight and coming from clean stock may be planted whole. Tubers weighing from 2 to 3 ounces should be split; 3 to 4½-ounce tubers should have the stem end cut off, then be split to bud end; 5-ounce tubers should be split from bud to stem end and then through the middle.

Handling Cut Seed

To insure good stands, do not allow cut seed to dry down rapidly before planting. The safest and easiest method of handling seed after it is cut is to plant immediately. Even if the cut seed is to be held only an hour or two it must have some protection on a hot, windy day. From the time it is cut until it is placed in the planter, the cut seed should be covered with wet burlap bags, or a tarpaulin, to prevent rapid drying of the cut surfaces. During the cool weather of early spring this protection is not so important. In a test at Wooster, cut seed was exposed for different periods of time before planting. The results were as follows:

Effect of Exposure of Cut Seed on Stand Obtained

Exposure Hours	Stand Per Cent
½	96
1	88
2	42
4	12

If weather conditions or other factors make it impossible to plant for several days after cutting, the seed will still be satisfactory, if properly healed. The healing process is not a complicated one. The following procedure should give good results:

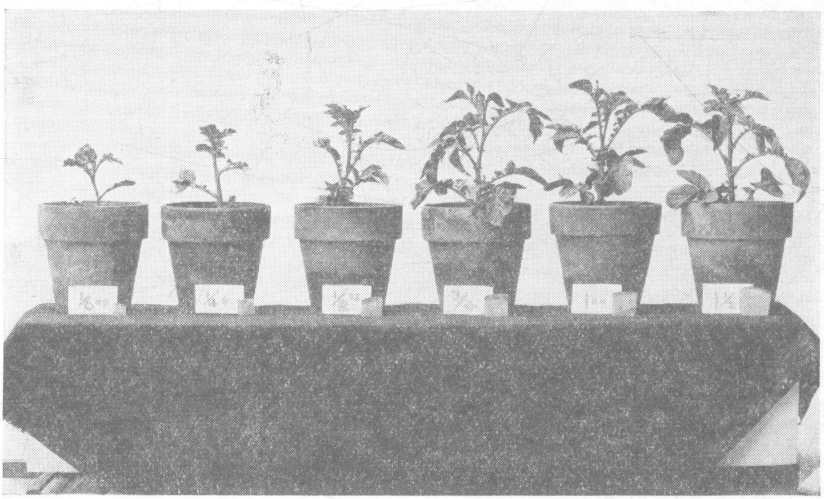
1. The storage and containers should be aired and disinfected to prevent development of molds and rots. A copper sulfate solution, 1 pound to 10 gallons of water may be used for disinfecting.
2. Place the cut pieces not over 8 inches deep in slatted crates. Offset crates in storage for good air circulation.
3. The best temperature is 60 to 65 degrees F. with a relative humidity of 85 per cent. The temperature and humidity must not vary to any great extent.
4. When the potatoes have stood for a day after cutting, they should be poured from one container to another to break apart the pieces that have stuck together.
5. The seed may be held under the above conditions for a week to ten days. After this time, the seed should be placed in cold storage. It can then be poured from crates into bags, if desired.

Properly healed cut seed can be expected to give good stands in dry, hot soils. Where plantings are delayed until hot weather, the use of healed seed or small whole seed will guarantee better stands.

Planting the Crop

Time of Planting

Potato tubers grow faster during cool nights than during warm nights. As summer temperatures in Ohio are above the optimum for maximum yields, the only means of offsetting the undesirable influences of high summer temperatures is to adjust the planting dates so that tuber development occurs in the cooler part of the season, either early or late.



Shows the growth from various sized pieces of Russets planted early in April.

The early crop can usually be planted as soon as the soil is in good condition to plow. Along the Ohio River, planting starts in late March; in northern Ohio, in late April. Early plantings are sometimes frosted, but if the plants are not over 8 inches high and the seed piece is in good condition, the frosted plants recover rapidly. Only on mucks, where the late spring frosts occur, is planting delayed until May.

Late varieties can be planted anytime from early April until June, but best yields are usually obtained from plantings made the latter half of May. The reason for the good yields lies in the fact that the plants have full advantage of the cool weather of September and early October. The highest yields are obtained on such plantings when the tops remain green until very near the date of killing frosts.

Plantings after the first of June are advised only when weather conditions prevent earlier planting.

Depth of Planting

It is essential that the seed pieces be planted deep. The depth should be 3½ to 4 inches on heavy soils and 4 to 5 inches on light soils. The tuber-producing stolons form above the seed pieces. Deep planting will provide "room" for the

Two-row planter with discs set for shallow covering.

development of a good set of tubers, and the *moisture* supply is more favorable for tuber development at 3 to 5 inches than at more shallow depths. Shallow planted potatoes may produce tubers that push out of the ground and become sunburned.

Deep working of the soil will facilitate deeper planting by allowing the planter

shoe to go deeper. Planter shoes wear rapidly, especially in stony soils. The shoe should be inspected each year and, if worn, replaced with a new one. If it is impossible to set the planter deep enough, a furrowing shoe can be placed in front of the planter. The planter shoe then follows in this furrow.

Most planters are equipped with disks set to throw a ridge over the seed. If the seed pieces are planted 3 to 5 inches deep and a 3- to 5-inch ridge is thrown over them, they will then be covered with 6 to 10 inches of soil. This condition will prevent proper healing, encourage injury by rhizoctonia, and result in poor stands.

For deep planting with shallow covering, which reduces rhizoctonia injury and gives better stands, the covering disks on the planter are set so that only 1½ to 2 inches of soil are thrown over the seed pieces, or the disks may be replaced with spring teeth. On light soils, the disks may be removed and a chain or board used to pull some soil over the seed. This type of planting allows quick emergence, and after the sprouts come through the soil is worked level, or slightly ridged, leaving the desired depth of planting.

Spacing of Hills

The distance between rows is governed chiefly by the width needed for cultivation. When the rows are less than 30 inches, the use of a cultivator becomes difficult. Row planting of 30 to 32 inches is most common.

There is no definite rule for determining the required distance between hills in the row. On the average soils, where no irrigation is available, the hills are commonly spaced about 12 inches apart. Closer spacing may lead to smaller average size tubers while further spacing may cause many oversize tubers and hollow heart.

On very fertile soils, where irrigation is used, it is suggested that the distance may be decreased to at least 9 inches, and perhaps even to 8 inches with Katahdins. Katahdins set fewer potatoes per hill than other varieties, and this closer spacing is essential to avoid a high percentage of oversized tubers.

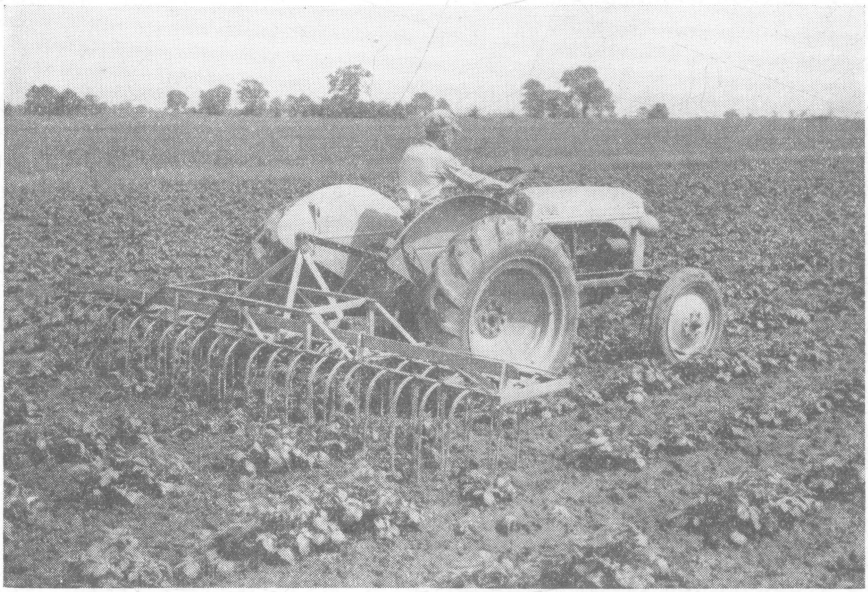
The amount of seed required to plant an acre of potatoes at the different spacings can be estimated from Table II.

Table II. Amount of Seed Required Per Acre

Spacing between hills in rows 32 inches apart	Weight of Seed pieces and amount of seed required per acre in 100-lb. bags	
	1 ounce	1½ ounces
	Bags	Bags
8 inches	15.3	23.1
9 inches	13.6	20.4
10 inches	12.2	18.3
11 inches	11.1	16.7
12 inches	10.2	15.3
13 inches	9.4	14.1

Cultivation and Weed Control

After the crop is planted, and before it comes up, rains often beat the soil together and prevent proper aeration. This condition may lead to suffocation and rotting of seed pieces. During this same period, weed growth is usually very rapid. The tools commonly used for cultivation and weed control during this period include harrows and weeders. The harrow works best on heavy soils, while a



The weeder cultivates, causing little damage to the root system but destroying germinating weed seeds.

weeder can be used on sandy ones. The teeth should be set deep enough so they will just pass over the seed pieces or young potato sprouts. This operation will loosen up the compacted soil as well as tear out, cover up, or otherwise destroy young weed seedlings. The value of a rotary hoe is questionable as the prongs cause considerable loss by picking up seed pieces.

During the period between planting and before the crop comes up, weeds must be controlled before they interfere with the growth of the crop. During recent years, 2,4-D and other chemicals have been tested for killing weeds in potato fields prior to crop emergence. Recommendations are changing from time to time, and newer materials are being discovered rapidly. Current recommendations for using weed killers on potatoes before the crop comes up will be available through the county agricultural agent. At the present time, no chemical weed killer is recommended after the crop comes up, with the possible exception of vine killers before harvest, discussed later.

As soon as the crop comes up, that is, as soon as the rows can be seen, the first cultivation is made. It should be deep and close to the plants. This cultivation is

followed by the weeder which will level the soil. The weeder is an important tool in potato production, and should be used often, especially after each rain. The teeth should be set 1 to 1½ inches deep. These cultivations kill young weeds but do little or no damage to the crop roots.

The weeder should be used in the heat of the day when plants are tough and not easily injured. The weeder should always be run in the same direction, causing the plants to fall regularly over the row. They will then shade the ground under the row and prevent weed growth.

When the soil becomes packed after a rain, it may be necessary to use a cultivator to loosen the soil. It should be equipped with sweeps to prevent root injury. After the cultivator is used, follow with the weeder.

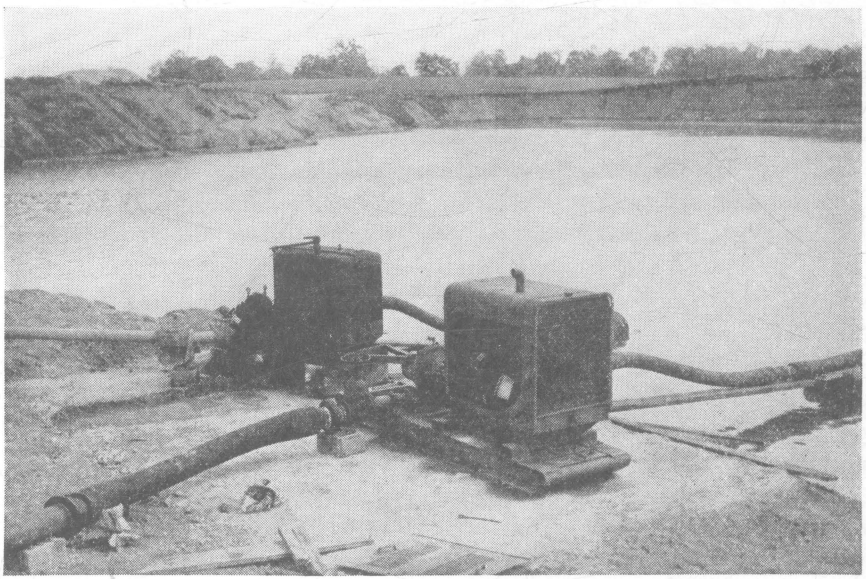
Hilling

Katahdins set shallow, so they should be planted deep and ridged as the season progresses to prevent the tubers from pushing out of the ground and becoming sunburned.

Other commercial varieties rarely need hilling, if planted at proper depth. However, these fields should also be watched closely as hilling is sometimes necessary near the end of the season to prevent sunburning. This is especially true where irrigation is available and large yields are expected.

Irrigation

Large increases in yield are often obtained from irrigation. These increases in yield are usually greatest on soils well adapted to potatoes. Irrigation increases



This gravel pit provides water for irrigating over 100 acres of potatoes.

yields, even in years of good rainfall, by preventing temporary checking of growth during dry periods.

In planning an irrigation system, one must be assured of an ample supply of water, either from rivers, creeks, ponds, or wells. When making an installation, all requirements must be carefully calculated; the amount of water, the pump capacity, and the power needed to offset friction and head. Irrigation equipment is expensive and mistakes are costly. The advice of an irrigation engineer should always be sought in planning an installation.

The popular method of irrigating potatoes is by the use of portable, lightweight pipe equipped with rotating sprinklers. Sprinklers are available that will water a circular area up to 300 feet across, depending on size and water pressure. After one area is watered sufficiently, the lateral lines are disassembled and moved to the new location.

To insure maximum yields, rainfall should be supplemented with irrigation, whenever the potatoes need water, regardless of stage of growth. There is a tendency to wait until growth is checked before applying water. The most critical periods in the growth of the crop, when a reduced water supply invariably results in reduced yields, are at the time the tubers are setting, and near maturity when the tubers are growing rapidly.

The present suggested practice is to supplement rainfall when needed so that the potatoes receive 1 inch of water per week. Recent experiments have indicated that more frequent applications of 1 inch of water may be profitable where made during the time tubers are setting; during the time the tubers are growing fast and nearing maturity; and during extreme hot weather.

Spraying and Dusting

Maximum yields of potatoes cannot be expected unless insects and diseases are controlled. Leafhoppers and flea beetles may cause serious injury unless controlled, and early blight and late blight frequently cause losses on potatoes that are not properly sprayed. Colorado potato beetles and aphids appear less often and require less attention for control.

Early blight frequently causes considerable defoliation on unsprayed potatoes, especially in central and southern Ohio. Late blight may appear both in the very early crop and on late crop potatoes in wet, cool periods, if the plants are not well protected with the proper fungicides.

Bordeaux mixture was used almost exclusively for many years for potato spraying and is still one of the best fungicides for the control of potato diseases. During the past few years, a number of new fungicides, such as Dithane, Parzate, Zerlate, and the fixed coppers, have been introduced for controlling early and late blight.

These new fungicides usually give good control of early blight and can be used where late blight is not serious, as would usually be the case on early maturing potatoes in Ohio. Zerlate gives poor control of late blight, and the use of a fixed copper frequently results in lower yields than Bordeaux, Dithane, or Parzate.

Bordeaux, Dithane, and Parzate give good control of late blight and early blight and are recommended for the general potato spraying schedule.

DDT is recommended in all potato sprays for control of the insects damaging the crop. It should not be omitted from any sprays during the season. The formula should provide for 1 pound of actual DDT per acre, per application. Two pounds of 50 per cent wettable powder per acre is required, regardless of the amount of spray used. The suggested formulas given below are based on 200 gallons of spray per acre. In early applications, where only 100 to 150 gallons may be used, the amount of DDT used should be increased so that 1 pound of actual DDT will be used per acre; thus, the formula for a 100-gallon application of a fixed copper and DDT would be 4–2–100, and for a 150-gallon application it should be 4–1½–100. DDT in emulsifiable oil gives somewhat better control of potato aphids than is obtained with wettable DDT powders. If aphids are a problem on potatoes, 1 quart of 25 per cent DDT in oil emulsion should be used in each 100 gallons of spray material instead of wettable DDT powder. The following spray formulas are recommended for use on potatoes in Ohio:

Bordeaux mixture + DDT 8–8–1–100
Dithane D-14 or liquid Parzate + DDT 4–1–1–100
Dithane Z-78 + DDT 2–1–100
Parzate + DDT 2–1–100
Zerlate + DDT 2–1–100
Fixed copper (Tribasic, Copper A, COC-S, etc.) + DDT 4–1–100

A 7- to 10-day interval between applications is recommended. Unless the weather becomes especially favorable for the development of early blight (warm and wet) or late blight (cool, wet nights), the 10-day interval is satisfactory. However, if late blight appears or threatens, then the interval between applications should be shortened to 7 or even 5 days for the duration of the critical period.

Bordeaux mixture is best prepared by thoroughly mixing the lime with half of the water to be used and stirring the dissolved copper sulfate into the lime-water mixture with the remainder of the water. In large-scale operations, either the powdered or snow form of copper sulfate may be placed on the screen and washed through with water into the lime-water mixture while the agitator is running. The DDT should be added last.

The *fixed coppers* require no lime and can be mixed directly with the DDT and water.

If liquid *Dithane* or *Parzate* is used, it may be added directly to the water in which the zinc sulfate has been dissolved.

Parzate, Dithane Z-78, and *Zerlate* may be added directly to the water in the spray tank, along with the DDT.

Adequate coverage of the young plants (first two sprays) can be obtained with 100 gallons per acre. As the plants become larger, it is advisable to increase the quantity of spray material with each successive application until about 200 gallons

per acre are used after the vines have reached their maximum size. Variations in the rate of application may be obtained by using nozzle disks with different sized openings, or by varying the rate of forward travel, although it is seldom advisable to exceed a maximum speed of 5 miles per hour while spraying or dusting.

Many of the fungicides mentioned above may be applied in dust formulations. Monohydrated copper sulfate and lime (20–80) was used as a potato dust for many years, and still is, to some extent. However, various formulations that include low-solubility (fixed) coppers that require no lime, or one of the three or four organic fungicides that are available in powder form, together with DDT and a diluent like talc or clay, have now almost replaced the older copper-lime dust. This replacement was hastened by the fact that the efficiency of DDT is considerably decreased in the presence of an excess of lime.

Typical dust formulations for use on potatoes are somewhat as follows:

A fixed copper (50% Cu) + DDT (50% active) + talc 14–6–80
Zerlate + DDT + talc 10–6–84
Dithane Z-78 + DDT + talc 8–6–86
Parzate + DDT + talc 8–6–86

Dusts should be applied at the rate of 30 to 40 (first application) up to 50 to 60 (later applications) pounds per acre. The initial deposit, adhesion, and consequently the final result is best, if the dust is applied in late evening or early morning while the plants are wet with dew and wind movement is at a minimum.

Spraying or dusting should begin when plants have emerged and continue regularly. Ten to twelve or more applications are necessary to protect the crop to harvest. Early applications are especially important for insect control and late applications just before harvest are important because of late blight in late maturing crops.

Sprayers and Dusters

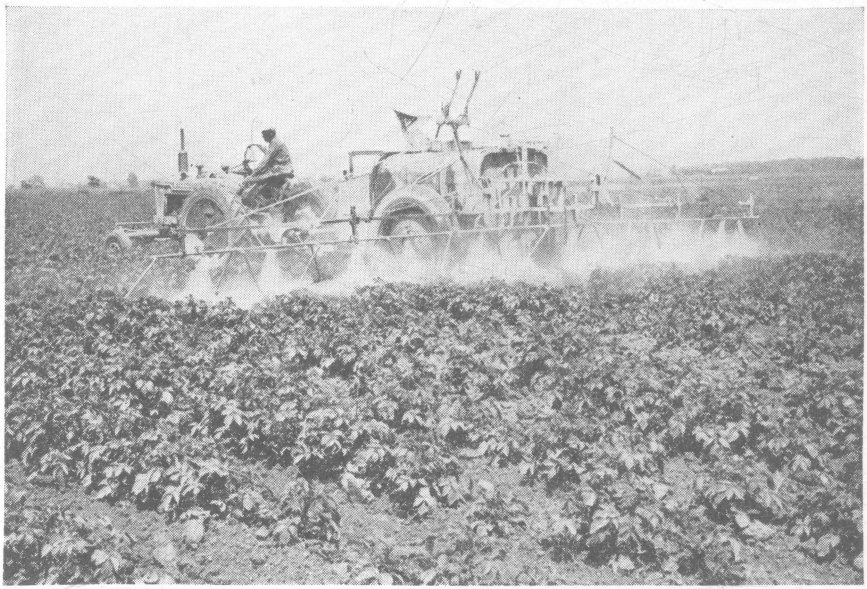
Spraying almost always gives more satisfactory disease and insect control than dusting, and is preferred by most growers for this reason. Trailer-mounted sprayers and dusters, pulled behind a tractor, are most popular. These sprayers or dusters may be operated from the power take-off, or independently powered with a gasoline engine. Truck-mounted units are also used by some growers. In some cases, small dusters are mounted directly on tractors by means of special attachments.

The number of rows sprayed or dusted varies from 4 to 12, but most large growers use 10- to 12-row equipment. The wider the swath the less is the wheel injury to the crop. Excessive wheel damage may be reduced somewhat by using large low-pressure tires and vine-lifters, wherever possible.

For spraying, the desired pressure is 300 to 400 pounds per square inch. A good rule to follow is to allow 1½ horsepower for each row to be sprayed. Three nozzles should be provided for each row and should be arranged for complete coverage of the plants. One nozzle may be placed directly over the row and one nozzle on a drop extension or lead on each side of the row. These side nozzles

should be adjustable so they may be moved sidewise to accommodate variations in plant size or row width. The boom assembly as a whole should be easily adjustable for height above ground.

The nozzles should be adjusted or arranged to obtain maximum coverage of the leaves. This is best provided by arranging them so that the cone patterns nearly converge (one slightly back of the other on the same row) at a central point which coincides with the potato row. This will set up a whirling motion of the spray mass which thereby gives maximum coverage. The overhead nozzle should be



A power sprayer showing boom and nozzle adjustments. The sprayer is driven by a power take-off from the tractor.

directly over the row being sprayed and about 12 to 15 inches above it, and the side nozzles about 12 to 24 inches from the center of the row, depending on the size of the vines, and 8 to 10 inches above the soil. Since nozzle discs often wear rapidly and thus increase the rate of application, they should be inspected at frequent intervals and changed when the openings have become noticeably larger. Also, during the spraying operation, the nozzles should be carefully watched for clogging. The sprayer should be rinsed with water after each period of use.

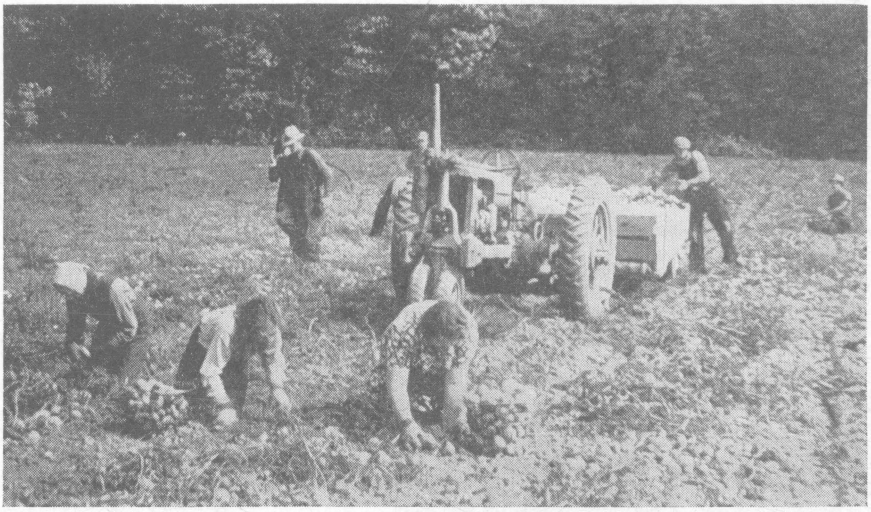
Dusters are usually constructed to provide for the use of two nozzles on each row but three may be used as in spraying. Here they also should be adjusted to provide maximum coverage. This can usually best be done by trial and observation until the dust cones overlap slightly at the center of the row with the outlets from opposite sides of the row offset enough so the two air blasts do not directly oppose each other; also, the outlets should be close enough to the plants to provide maximum penetration of the foliage mass by the dust particles.

Concentrated liquid sprays and wetted dusts are receiving much attention at

the present time. Their use looks promising for the future but are definitely not recommended at the present time.

Harvesting the Potatoes

It is best to let the tubers mature before digging, unless some unusual situation makes it desirable to dig them earlier. Tuber development continues until the plant matures. With full maturity, the periderm (skin) is thick, tough, and more resistant to injury. When the plants are killed by frost, 10 to 14 days will be



Careful handling reduces injury to tubers at harvest.

required before the periderm becomes as thick as that of tubers from matured plants. Potatoes dug before maturity have a thin periderm that rubs off easily, and are unslightly. Immature potatoes also shrink much more than mature potatoes after harvest.

Killing Vines Before Harvest

Several methods are now available for killing potato vines and other vegetation before digging. These methods include: (1) chemicals, such as sodium arsenite, forms of Cyanamid, and pentachlorophenol; (2) flame throwers or burners which are run over the field twice; (3) machines that beat the vines, chop them up and leave them lying on the ground.

With these methods, the growing season can be terminated at any time. The tubers will mature, the skin becoming thick and tough, in about 10 to 14 days after the vines are killed. Digging is made easier by eliminating vines and weeds, and pickers will usually pick up enough additional potatoes to pay the expense of the treatment.

Some internal discoloration of tubers occurs following all methods of vine killing. Little is known about the cause of this trouble, which seems to be affected by variety, temperature, maturity, and the season. The risk of discoloration should be recognized when vine killing is to be done.

Chemicals (sodium arsenite, Cyanamid, pentachlorophenol, etc.) kill vines and some weeds effectively. They are inexpensive and may be used in regular sprayers. The rate of kill varies widely with conditions, and grasses may come up rapidly if digging is delayed. Dead foliage remains on the field.

Flame throwers kill vines and weeds instantly. A second burning several days later consumes the dead foliage. The burner does a very satisfactory job, but is expensive and its use limited to large growers or "rings." Operating costs run several dollars per acre, mostly for the oil used. An advantage is that the field is left bare for harvesting, although some organic matter is lost through the burning.

Rotary beaters are equipped with flails which revolve rapidly to pulverize vines and weeds. The machines are driven by power take-off from the tractor, and a 3-plow tractor is best. The shredded foliage is spread over the field and does not interfere with harvesting. Careful adjustment of the machine is necessary. When set too high, the vines are not completely destroyed. When set too low, the flails damage potatoes that are at or near the surface and cause losses. The machine is less expensive to buy and operate than the flame thrower, and will do a reasonably good job in the hands of a careful operator.

Experience in Ohio with all methods of vine killing is not extensive, and the relative merit of these methods of vine killing are not well defined. For early potatoes, the problem usually is to clear the field, and the flame thrower or rotary beater has been most successful. For late potatoes, where weed growth is not serious, the chemicals have an advantage in their low cost.

Preventing Mechanical Injuries

Too little attention is given to mechanical injuries at harvest time. Injuries at that time may appear slight, but prove serious later. If exposed to bright sunshine, skinned areas later turn black and, under certain conditions, become slimy; at other times, they become dry or crusty. There will be more shrinkage from tubers that are skinned, bruised, or cut. Disease organisms may enter these injuries and cause decay and the appearance of the tuber is marred by the discoloration of the skin.

The following are some suggestions that will help avoid mechanical injury:

1. Allow potatoes to mature before digging.
2. Select a digger wide enough to harvest the potatoes without cutting them.
3. Set the digger blade deep enough to avoid cutting, and keep it in the middle of the row. Do not let moist soil collect on the wheels, as this tends to lift the blade.
4. Carry sufficient soil over the chain to prevent the tubers from bouncing around on the iron rods. If the soil passes too rapidly through the chain, replace the *elliptical agitators* under the chain with rollers. Slowing down the speed of the elevator apron is another way to prevent too rapid separation and resulting mechanical injury.
5. On loose soils, it will be advantageous to convert the two aprons into a continuous unit or chain.

6. Diggers can be improved by covering the shaker attachment with rubber hose and the sides with canvas. The ends of the rods or hooks on the chain can be covered with a light steel plate or old inner tubing bolted to the frame above the apron.
7. A pair of revolving disks placed on each side of the digging blade can be adjusted to throw the tubers on the outer edge of the row, along with vines and dirt onto the elevator chain.
8. Line picking baskets with burlap or use rubber covered wire baskets. Do not allow freshly dug potatoes to be thrown, dropped, or walked upon. Use care in running them over the sizer.

Other Digging and Handling Precautions

On bright, sunshiny days, the potatoes must be picked up soon after digging. During the summer months, freshly dug tubers should not be left lying in the sun for longer than 1 hour. On days when the sun is not shining, potatoes may be dug and left on the ground for longer periods.

Potatoes that lie in the sun for any length of time are likely to become sun-scalded. This is especially true with skinned or cut tubers, but can happen to others. This sun-scald injury is not visible immediately, but a soft rot develops in a few days, often after the potatoes have left the farm. The rot first appears as a watery spot $\frac{1}{8}$ to $\frac{3}{8}$ inches deep and covering only a part of the tuber. A storage temperature of 60 degrees F. and a relative humidity of 85 per cent will practically stop the development of sun-scald. These storage conditions are also favorable for healing skinned and injured tubers.

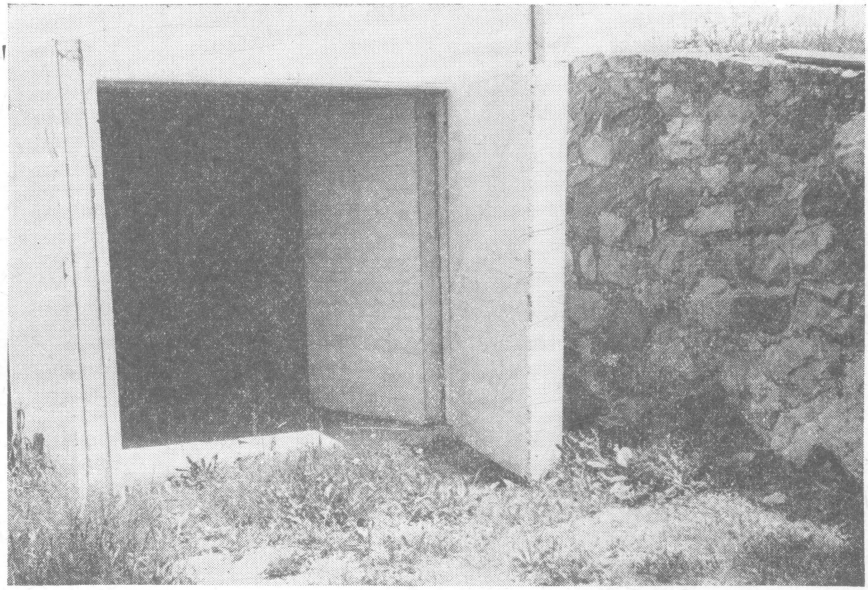
Another type of injury called sunburn is caused by prolonged exposure to light. The skin and flesh of the exposed tubers turn green and become unfit for table use.

Many losses can be avoided by careful handling, by picking up promptly after digging, and by covering the loads as they are hauled to the sorting shed or to storage.

Potato Storage

Storage is an essential part of the orderly marketing of potatoes. Storage houses may be remodeled barns, an underground storage, or a refrigerated building. Many satisfactory storages can be made of barns and sheds by adding insulation, double doors, rat proofing, and providing ventilation. Slatted floors, false walls, and vertical air tunnels improve air circulation through the storage. Fans help force air through the storage for rapid cooling. Engineering assistance should be obtained when building a storage to insure a house that will successfully store the crop.

There are four major periods in the storage of a crop: the curing period, the dormant period, storage after the dormant period, and the warming up. Each period requires special management of the storage.



Double insulated doors on ground floor entrance to storage in a bank barn. Storage is filled from upper level and potatoes are removed through this entrance.

The Curing Period

When potatoes are dug, they should be placed in a storage maintaining a temperature of 60 to 70 degrees F. and 85 per cent humidity for 7 to 10 days. During this period, bruised and cut potatoes are healed by the formation of new skin which reduces shrinkage and rotting. If potatoes are temporarily kept in an open packing shed during dry weather, the exposed cuts and bruises dry down instead of healing. Under the dried wounds, rots will start. The most common cause of rotting in Ohio arises from failure to unload potatoes into a place where high humidity can be maintained for a few days.

When first placed in storage, potatoes give off moisture rapidly (sweat). Excess moisture, not removed in the ventilation required to cool the potatoes, may accumulate on walls and ceilings and drip back on the potatoes. This moisture will not damage the potatoes but makes them disagreeable to handle and can be reduced by ventilation. After the 10-day curing period, the storage should be cooled down slowly, using the cool night air. The humidity should be allowed to rise to prevent shriveling.

The Dormant Period

Potatoes are in their dormant stage for two or three months after harvest. During this period, they will not sprout. The dormant period for Cobblers dug in August ends in November, and for late potatoes in December or January. Although not necessary to prevent sprouting, the storage should be kept cool and humidity high to prevent shriveling. If the potatoes are to be used for table stock

before the dormant period is over, the quality is better when held at 50 to 60 degrees F. than when held at lower temperatures.

Storage After the Dormant Period

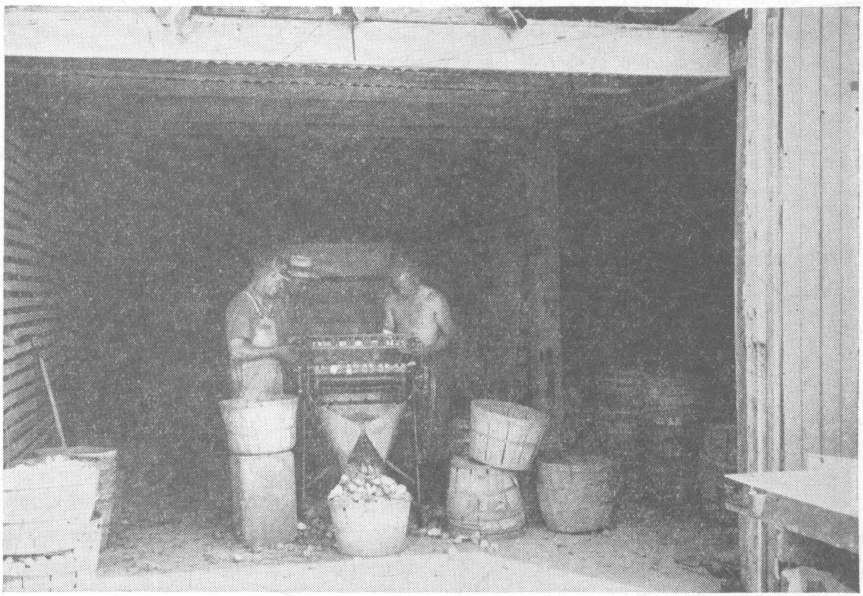
When the potato nears the end of the dormant period, it must be cooled to 38 degrees F. or lower to prevent sprouting. Tubers generate some heat, so, it is necessary to cool the storage down to 36 degrees F., or lower, to prevent sprouting in the pile.

To cool a filled storage to 36 degrees F. requires special care during November and early December. The ventilators should be opened during cool periods and closed on warm days. Injury from unexpected frost is possible, but not likely, if reasonable attention is given to ventilation. Except for control of temperature, no special ventilation is needed.

To prevent or delay sprouting in storage, it is possible to apply a hormone to the tubers as they are placed in the storage. The material suggested is the methyl ester of naphthalene acetic acid and is sold under several trade names that indicate the use of the material. If potatoes are to be used before the end of the dormant period, there is no advantage in using the material. The inhibitor should not be used on potatoes to be used for seed, nor can it be expected to take the place of good storage.

The Warming Up Period

When held at low temperatures, the tubers will accumulate sugar as the result of hydrolysis of starch, and they may taste sweet when cooked. Chips or french



An inexpensive storage built into a barn. Walls are insulated. Slatted air passage provides circulation along walls.

fries made from potatoes held at low temperatures will be brown because the sugar carmelizes. Tubers held at low temperatures will have their cooking quality restored, if removed from storage and held several days at 60 to 70 degrees F. This will transform the accumulated sugar back into starch.

Pit Storage

Pit storage of potatoes is suggested only where common or refrigerated storage is not available and the crop cannot be moved before winter. The potatoes are placed in a pit or in a rectangular pile on the ground and covered with alternate layers of straw and soil. The underlying soil must be well drained, and straw and soil must be added in quantities that will prevent freezing of the potatoes. This type of storage is rather inconvenient and is suggested only as a last resort.

The Marketing of Potatoes

Potato growing does not end when the crop is dug. The potatoes must be stored, prepared for sale, and sold successfully before they can be converted into

An efficient bagging set-up. Filled at the grader, the bags are set on the "over-under" scales and the fill weight adjusted. Bags are closed with wire ties and loaded on pallets or directly on the truck for delivery.

cash. The success of the marketing job often determines whether there is a profit or loss in potato growing. The important factor in profit, after a good crop has been grown, is the price obtained. Price depends on many factors, in addition to "supply and demand." Consumer buying habits, size of package, *uniformity of quality*, regular availability of a branded package, price supports, freight rates from surplus states, etc.

Consumers have the last word in selling. They spend the money which pays

for marketing costs and provides the returns to growers. A study of consumer preferences, conducted by U. S. Department of Agriculture, showed that housewives want a medium-sized potato with smooth, clean surface, few eyes, and free from spots or blemishes. The potato should cook mealy, evenly, and not fall apart in cooking. The housewives also say that quality is most important, size second, and price least important, when buying potatoes. Preparation for sale must include such operation as sizing, cleaning, inspection, and packaging that will meet the demands of the consumer.

The mere fact that Ohio has a large consuming population does not guarantee the markets to Ohio producers. The consumers care little where the potatoes are produced, and their preference determines the source of supply. Ohio growers are fortunate in having ready markets. They can hold these markets only by packing potatoes that equal the attractiveness and quality of shipped-in potatoes.

Sizing Machines

These machines are commonly misnamed "graders." They size the potatoes only by the use of meshed chains or belts; the undersized potatoes drop through, while the ones of desired size are carried over the sizing belt. However, the defective tubers, such as the sunburned, cut, bruised, misshapened, and diseased ones, must be removed by hand. This is facilitated by equipping the sizing machine with a picking table long enough to accommodate several pickers. The rolling picking table is preferred over the belt type because the rollers turn the tubers so all sides are easily seen, if well lighted. Pickers should be familiar with grade requirements.

Cleaning the Potatoes

Brushes for cleaning the potatoes are available as equipment on sizing machines. Dry and mature potatoes are not easily skinned and can be cleaned so the appearance is greatly improved by using these brushes.

Washing improves the appearance of the crop considerably but presents several problems. If the crop contains diseased tubers, the washing vat becomes contaminated and succeeding potatoes become inoculated. No grower should attempt to wash potatoes unless he also has facilities for drying them thoroughly before they are packaged. Otherwise, the tubers are likely to rot and serious losses will follow. Even though the potatoes may show no signs of rotting when they leave the farm, this is no indication that they will keep for any great length of time.

Packaging

Quality potatoes in packages are handled in 15-pound and 50-pound paper bags, with a limited number of 10-pound bags in use. The 100-pound bag is sometimes used for commercial consumers, such as restaurants, chip makers, etc., and for such retailers who maintain bulk sales. Off grades are usually sold in large sacks.

Efficient packaging and weighing equipment is necessary, if costs are to be kept down. Special scales showing "over" and "under" weights are available. Extra

Some defects that are not permitted in U. S. No. 1 Grade.

1. Wireworm injury.
2. Bruises and cuts caused by rough handling.
3. Pitted scab.
4. Shatter bruise.
5. Surface and deep pitted scab.
6. Bad growth cracks.
7. Hollow heart.

weight to allow for shrinkage must be packed so bags are not underweight when purchased. Usually, 15½ pounds are packed in a 15-pound peck bag.

Brands and Labeling

Brand names on quality potatoes build a future market and repeat sales. If quality is not maintained, the opposite is true. A brand may be used by a grower association or by an individual grower. Regardless, a steady supply of uniform quality potatoes is necessary to make the best use of a brand name.

State laws required that the package be labeled with the grower's or packer's name, address, name of state where grown, net contents by weight, and the grade as established by the State of Ohio. Federal grades are established as the grades of Ohio.

Federal-State Inspection

Official inspection and certification of the grade may be obtained from the Bureau of Markets, Ohio Department of Agriculture, Columbus, on the payment of a small fee. This assures the buyer of receiving potatoes of the quality indicated, and protects the seller, if there is a dispute concerning grades.

Grading schools are held so that growers can familiarize themselves with the grade before packing operations start.

Market Information

Prices and other market information are published frequently by USDA Production and Marketing Administration in terminal markets. Current market information is also available through grower associations. Often price and market information from buyers is for the purpose of lowering prices, and sales made on such information only upset the market further.

Cooperative Marketing

Grower-owned and operated marketing associations to promote good marketing are active in Ohio, as well as in other states. Association controlled brands are available through a longer marketing period, and repeat business is built. A central sales office eliminates price competition between growers and supervises the quality of the pack. Buyers place orders with the central sales office which assigns to growers who deliver direct. Growers may sell their own potatoes but must meet all association requirements on quality and price. Advertising, accepted brands, and regular orderly sales are made possible by such grower cooperation.

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